

IN THE CLAIMS

Please amend the claims as follows:

1-15. (Cancelled)

16. (Withdrawn) The material in accordance with Claim 1, wherein the proton conducting ceramic phase has a pyrochlore structure of  $(A'^{2+}A''^{3+})_2(B_{2-\eta}R_\eta)O_{7+\lambda}$  wherein A' is a trivalent cation, A'' is a divalent cation, B is a tetravalent cation and R is a divalent cation.

17. (Withdrawn) The material in accordance with Claim 16, wherein A'' and R are identical cations.

18. (Withdrawn) The material in accordance with Claim 16, wherein  $0 \leq \gamma \leq 0.3$ .

19. (Withdrawn) The material in accordance with Claim 16, wherein  $0 \leq \eta \leq 0.3$ .

20. (Cancelled)

21. (Withdrawn) The material in accordance with Claim 20, wherein the complex perovskite has a structure of  $A_2(B'^{3+}\beta B''^{5+})_{1-\beta}O_{6+\lambda}$ , wherein A is a divalent ion, B' is one of a trivalent ion and a tetravalent ion, and B'' is a pentavalent ion.

22. (Withdrawn) The material in accordance with Claim 21, wherein  $0 \leq \beta \leq 0.3$ .

23. (Withdrawn) The material in accordance with Claim 21, wherein  $0 \leq \varphi \leq 0.2$ .

24. (Withdrawn) The material in accordance with Claim 20, wherein the complex perovskite has a structure  $A_3(B'^{3+}\beta B''^{5+})_{2-\beta}O_{9+\lambda}$ , wherein A is a divalent ion, B' is one of a trivalent ion and a tetravalent ion, and B'' is a pentavalent ion.

25. (Withdrawn) The material in accordance with Claim 24, wherein  $0 \leq \beta \leq 0.3$ .

26. (Withdrawn) The material in accordance with Claim 24, wherein  $0 \leq \phi \leq 0.2$ .

27-29. (Cancelled)

30. (New) A multi-phase ceramic composite material comprising:

- a proton conducting ceramic phase having a protonic conductivity greater than about  $1.0 \times 10^{-3}$  S/cm at an operating temperature; and
- an electron conducting ceramic phase with electronic conductivity greater than  $1.0 \times 10^{-2}$  S/cm when measured under reducing conditions with an oxygen partial pressure less than about 0.05 atm, said electron conducting ceramic phase comprising at least a portion that is not the product of a reaction involving the proton conducting ceramic phase; and
- wherein the material is substantially gas impermeable when sintered.

31. (New) The material in accordance with Claim 30, wherein the electron conducting ceramic phase is structurally and chemically identical to at least one product of a reaction between the proton conducting phase and at least one expected gas under operating conditions of a membrane fabricated using the material.

32. (New) The material in accordance with Claim 30, wherein the electron conducting ceramic phase has a form  $\text{Ce}_{1-x}\text{B}_x\text{O}_{2-\epsilon}$ , wherein B is selected from the group consisting of yttrium and an element belonging to the Lanthanide series in the periodic table, x is between about 0 and about 0.75, and  $\epsilon$  is an oxygen deficiency.

33. (New) The material in accordance with Claim 32, wherein x is between about 0.2 and about 0.3.

34. (New) The material in accordance with Claim 31, wherein the electron conducting ceramic phase has a form  $\text{Ce}_{1-x}\text{B}_x\text{O}_{2-\epsilon}$ , wherein B is selected from the group consisting of yttrium

and an element belonging to the Lanthanide series in the periodic table; x is between about 0 and about 0.75, and ε is an oxygen deficiency.

35. (New) The material in accordance with Claim 34, wherein x is between about 0.2 and about 0.3.

36. (New) The material in accordance with Claim 30, wherein the proton conducting ceramic phase has a perovskite structure.

37. (New) The material in accordance with Claim 36, wherein the electron conducting phase comprises a ceria.

38. (New) The material in accordance with Claim 36, wherein the electron conducting phase comprises a doped ceria.

39. (New) The material in accordance with Claim 36, wherein the perovskite has a form  $A_{1-x-y}P_xB_{1-y}Q_yO_{3-\delta}$ ; wherein A is a bivalent cation selected from the group consisting of barium (Ba), strontium (Sr), calcium (Ca) and magnesium (Mg) and combinations thereof; wherein P is an A-site dopant that is a cation; wherein B is a tetravalent cation selected from the group consisting of an element in Group IV of the period table and an element in the lanthanide series of the periodic table; wherein Q is a B-site dopant selected from the group consisting of an element in Group III of the period table and an element in the lanthanide series of the periodic table; and wherein α is between about 0 and about 0.1, x is between about 0 and about 0.5, and y is between about 0 and about 0.3, α is a non-stoichiometric A-site deficiency, and δ is an oxygen deficiency.

40. (New) The material according to claim 39, wherein the A-site dopant is a cation selected from the group consisting of Pr, Sm, Er and an element in the lanthanide series of the periodic table.

41. (New) The material in accordance with Claim 39, wherein  $\alpha$  is a non-stoichiometric A-site deficiency.

42. (New) The material in accordance with Claim 39, wherein  $\delta$  is an oxygen deficiency.

43. (New) The material in accordance with Claim 30, where the proton conducting ceramic phase is a complex perovskite.

44. (New) The material in accordance with Claim 30, further comprising a secondary ceramic phase added below a percolation limit to improve thermodynamic stability.

45. (New) The material in accordance with Claim 30, further comprising a second electronically conducting phase selected from the group consisting of tin oxide ( $\text{SnO}_2$ ), doped  $\text{SnO}_2$ , tungsten oxide ( $\text{WO}_3$ ), doped  $\text{WO}_3$ , cobalt oxide ( $\text{CoO}_2$ ), doped  $\text{CoO}_2$  and silicon carbide ( $\text{SiC}$ ).

46. (New) The material in accordance with Claim 30, wherein the amount of the electron conducting ceramic phase is at least the percolation limit of the electron conducting ceramic phase in the material.

47. (New) The material in accordance with Claim 30, wherein the amount of the electron conducting ceramic phase is about 50% by volume of the material.

48. (New) The material in accordance with Claim 30, further comprising an amount of electron conducting ceramic phase sufficient to prevent the formation of carbonate when the material is in the presence of carbon dioxide.

49. (New) The material in accordance with Claim 30, further comprising an amount of the electron conducting ceramic phase sufficient to prevent the formation of hydroxide when the material is in the presence of water.

50. (New) The material in accordance with Claim 1, wherein the proton conducting phase and the electron conducting phase are present in the material in sufficient quantities such that the material is impermeable to gas when sintered.

51. (New) A multi-phase ceramic composite material comprising:

- a proton conducting ceramic phase having a protonic conductivity greater than  $1.0 \times 10^{-3}$  S/cm at an operating temperature; and
- an electron conducting ceramic phase with electronic conductivity greater than  $1.0 \times 10^{-2}$  S/cm when measured under reducing conditions with an oxygen partial pressure less than 0.05 atm, said electron conducting ceramic phase forming at least one contiguous path between opposing ends of the material such that electrons may pass through the material;
- wherein the material is substantially gas impermeable when sintered.

52. (New) The material in accordance with Claim 51, wherein the electron conducting ceramic phase is structurally and chemically identical to at least one product of a reaction between the proton conducting phase and at least one expected gas under operating conditions of a membrane fabricated using the material.

53. (New) The material in accordance with Claim 51, wherein the electron conducting ceramic phase has a form  $Ce_{1-x}B_xO_{2-\epsilon}$ , wherein B is selected from the group consisting of yttrium and an element belonging to the Lanthanide series in the periodic table, x is between about 0 and about 0.75, and  $\epsilon$  is an oxygen deficiency.

54. (New) The material in accordance with Claim 53, wherein x is between about 0.2 and about 0.3.

55. (New) The material in accordance with Claim 52, wherein the electron conducting ceramic phase has a form  $Ce_{1-x}B_xO_{2-\epsilon}$ , wherein B is selected from the group consisting of yttrium

and an element belonging to the Lanthanide series in the periodic table, x is between about 0 and about 0.75, and ε is an oxygen deficiency.

56. (New) The material in accordance with Claim 55, wherein x is between about 0.2 and about 0.3.

57. (New) The material in accordance with Claim 51, wherein the proton conducting ceramic phase has a perovskite structure.

58. (New) The material in accordance with Claim 57, wherein the electron conducting phase comprises a ceria.

59. (New) The material in accordance with Claim 57, wherein the electron conducting phase comprises a doped ceria.

60. (New) The material in accordance with Claim 57, wherein the perovskite has a form  $A_{1-x}$ .  
 $_xP_yB_{1-y}Q_3O_{3-\delta}$ ; wherein A is a bivalent cation selected from the group consisting of barium (Ba), strontium (Sr), calcium (Ca) and magnesium (Mg) and combinations thereof; wherein P is an A-site dopant that is a cation; wherein B is a tetravalent cation selected from the group consisting of an element in Group IV of the period table and an element in the lanthanide series of the periodic table; wherein Q is a B-site dopant selected from the group consisting of an element in Group III of the period table and an element in the lanthanide series of the periodic table; and wherein α is between about 0 and about 0.1, x is between about 0 and about 0.5, and y is between about 0 and about 0.3, α is a non-stoichiometric A-site deficiency, and δ is an oxygen deficiency.

61. (New) The material according to claim 60, wherein the A-site dopant is a cation selected from the group consisting of Pr, Sm, Er and an element in the lanthanide series of the periodic table.

62. (New) The material in accordance with Claim 60, wherein  $\alpha$  is a non-stoichiometric A-site deficiency.

63. (New) The material in accordance with Claim 60, wherein  $\delta$  is an oxygen deficiency.

64. (New) The material in accordance with Claim 51, where the proton conducting ceramic phase is a complex perovskite.

65. (New) The material in accordance with Claim 51, further comprising a secondary ceramic phase added below a percolation limit to improve thermodynamic stability.

66. (New) The material in accordance with Claim 51, further comprising a second electronically conducting phase selected from the group consisting of tin oxide ( $\text{SnO}_2$ ), doped  $\text{SnO}_2$ , tungsten oxide ( $\text{WO}_3$ ), doped  $\text{WO}_3$ , cobalt oxide ( $\text{CoO}_2$ ), doped  $\text{CoO}_2$  and silicon carbide ( $\text{SiC}$ ).

67. (New) The material in accordance with Claim 51, wherein the amount of the electron conducting ceramic phase is at least the percolation limit of the electron conducting ceramic phase in the material.

68. (New) The material in accordance with Claim 51, wherein the amount of the electron conducting ceramic phase is about 50% by volume of the material.

69. (New) The material in accordance with Claim 51, wherein the amount of the electron conducting ceramic phase is sufficient to prevent the formation of carbonate when the material is in the presence of carbon dioxide.

70. (New) The material in accordance with Claim 51, wherein the amount of the electron conducting ceramic phase is sufficient to prevent the formation of hydroxide when the material is in the presence of water.

71. (New) The material in accordance with Claim 51, wherein the proton conducting phase and the electron conducting phase are present in the material in sufficient quantities such that the material is impermeable to gas when sintered.

72. (New) A multi-phase ceramic composite material comprising:

- a proton conducting ceramic phase having a protonic conductivity greater than  $1.0 \times 10^{-3}$  S/cm at an operating temperature;
- an electron conducting ceramic phase with electronic conductivity greater than  $1.0 \times 10^{-2}$  S/cm when measured under reducing conditions with an oxygen partial pressure less than 0.05 atm and wherein the amount of the electron conducting ceramic phase is sufficient to prevent the formation of carbonate in the presence of carbon dioxide and the formation of hydroxide in the presence of water; and
- wherein the material is substantially gas impermeable when sintered.